Bat Surveys on Theodore Roosevelt National Wildlife Refuge Complex

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Draft Interim Report
May 2008

ABSTRACT

Mist net, Anabat, telemetry, and roost surveys were conducted from April – October, 2007 to determine bat species diversity and relative abundance on Theodore Roosevelt National Wildlife Refuge (NWR) Complex. An emphasis was placed on locating foraging and roosting habitat for Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) and southeastern myotis (*Myotis austroriparius*). Sixty-one sites were scouted on Morgan Brake NWR, Hillside NWR, Panther Swamp NWR, and Yazoo NWR to determine mist net and/or AnaBat suitability. Mist net surveys were conducted at 23 sites over 28 nights (5 sites at Morgan Brake NWR and 6 sites each at Hillside NWR, Panther Swamp NWR, and Yazoo NWR). A total of 201 bats were captured representing 5 species averaging 7.18 bats captured per net night. Forty-seven southeastern myotis were captured representing 22% of the total number of bats captured. Other bat species captured during the survey period included the: evening bat (*Nycticeius humeralis*) (74% of the total bat captures), red bat (*Lasiurus borealis*) (3%), Seminole bat (*Lasiurus seminolus*) (0.5%), and Eastern pipistrelle (*Pipistrellus subflavus*) (0.5%). Out of the 4 refuges, Panther Swamp NWR had the highest capture average with 12.88 bats captured per net night. Capture averages for the other 3 refuges were: 6.5 bats captured per net night at Yazoo NWR, 4.57 at Morgan Brake NWR, and 2.8 at Hillside NWR. Yazoo NWR had the highest species diversity with 5 species captured (red bat, evening bat, southeastern myotis, Seminole bat, and Eastern pipistrelle). Three species (red bat, evening bat, and southeastern myotis) were captured each at the other 3 refuges. To further document species diversity and relative bat activity on the refuges, an AnaBat Bat Detector was used at 8 locations over 16 nights from June – September, 2007. Over 10,000 calls were recorded and are currently being analyzed to determine suitability for analysis and to identify bat species. Eleven southeastern myotis were fitted with radio transmitters in an attempt to locate roosts using standard radio telemetry procedures. Although signals were received, no roosts were found. One abandoned building at Panther Swamp NWR and 24 bridges located at the 4 refuges were surveyed for bat occupancy with no bats observed. Over 750 acres were scouted on foot in an attempt to locate tree roosts for Rafinesque's big-eared bat and southeastern myotis. Although numerous cavity trees were located, no bats were observed.

INTRODUCTION

Worldwide there are nearly 1,000 bat species representing almost a quarter of all mammal species (Bat Conservation International 1993). They are the second largest order of mammals in number of species, (second only to rodents) and can occupy virtually every habitat worldwide except in the most extreme desert and polar regions (Fenton 1992). Forty-five bat species are native to the United States with 15 living in the southeast. Nearly 40% of these species are threatened or endangered, and around the world, many more are declining at alarming rates (Bat Conservation International 1993). Six U.S. species are listed as endangered and 20 are considered species of special concern by the U.S. Fish and Wildlife Service (Harvey et al. 1999). Out of the 14 bat species found in Mississippi, 2 are endangered and 7 more are species of special concern (Mississippi Natural Heritage Program 2001).

Conservation Status of Rare Bat Species in Mississippi

The Indiana bat (*Myotis sodalis*) is a federally endangered species that has historically been documented in Mississippi. Indiana bats have not been observed in the state since 1967 and were listed in 1995 as extirpated by the Mississippi Natural Heritage Program (MNHP) (2001a). The gray bat (*Myotis grisescens*) is also federally listed as endangered and has historically been documented in Mississippi. Until 2004, gray bats had not been recorded in Mississippi since 1967. However in September 2004, a dead gray bat was found in Belmont, Mississippi (Sherman and Martin 2006), in Tishomingo County. This is a substantial finding given that the MNHP (2001a) had listed the gray bat in 1995 as extirpated from Mississippi. Gray bats require large caves for roost sites and would likely only be found in the northeastern part of the state.

The northern long-eared bat (*Myotis septentrionalis*) is listed as a species of special concern in Mississippi with only 1 record documented in the MNHP Database. One northern long-eared bat was observed in an abandoned chalk mine in Tishomingo County in both 1967 and 2004. Northern long-eared bats require caves to hibernate in during the winter. During the summer months, this species is usually associated with areas containing caves and/or mines. Northern long-eared bats prefer mountainous regions and therefore would likely only be found in the northeastern part of the state.

The hoary bat (*Lasiurus cinereus*) is another special concern species in Mississippi with 5 records documented in the MNHP Database. This species is thought to be a generalist in terms of habitat requirements and fairly common through-out its range. However, given the low number of records for this species in Mississippi, additional surveys are necessary to more adequately determine relative abundance and habitat requirements.

We have very few records for the northern yellow bat (*Lasiurus intermedius*), little brown bat (*Myotis lucifugus*), and silver-haired bat (*Lasionycteris noctivagans*) in Mississippi and it is likely that they no longer occur in the state as year round residents.

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) and southeastern myotis (*Myotis austroriparius*) are two special concern species in Mississippi. Due to intensive survey efforts over the last 12 years, county records in the MNHP have increased from 6 to 22 records for Rafinesque's big-eared bat and from 5 to 19 records for southeastern myotis. These 2 species are the focus species for the current project.

Rafinesque's Big-eared Bat and Southeastern Myotis

Rafinesque's big-eared bat and southeastern myotis are two rare bat species found in the southeastern United States. Both of these species have similar geographic and ecological distributions and show a preference for comparable foraging and roosting habitats (National Biological Resources 1995, Clark 2000a). They can be found in bottomland hardwood (BLH) forests using large hollowed out trees as roosts (Horner and Maxey 1998, Clark 2000b, Bat Conservation International 2001, Kentucky Bat Working Group 2003), particularly water tupelo (*Nyssa aquatica*) and bald cypress (*Taxodium distichum*) (Hofmann et al. 1999, Clark 2000a). In the northern states within their range, they are prevalent in caves. However, in states such as Mississippi where caves are rare, they are more commonly found occupying tree roosts and man-made structures. Rafinesque's big-eared bat and southeastern myotis are species of special concern in Mississippi (Mississippi Natural Heritage Program 2001) and their population numbers

are thought to be declining regionally (Gore and Hovis 1992, Clark 2000b, Bat Conservation International 2001, Kentucky Bat Working Group 2003).

Conservation Status

Rafinesque's big-eared bat and southeastern myotis were formerly listed as category 2 species (a classification no longer in use) under the Federal Endangered Species Act, meaning that these species were possibly endangered or threatened, but sufficient data for classification were lacking. Rafinesque's big-eared bat is federally listed as a species of special concern and state listed as endangered, threatened or a species of special concern throughout its range. Southeastern myotis is federally listed as a species of special concern and state listed as endangered, threatened or a species of special concern in every state within its range, excluding Florida. Surveys conducted prior to 1990 estimated the numbers of southeastern myotis in Florida at 400,000 adult females, located in 15 maternity caves (Gore and Hovis 1992). However, in 1991 fewer than 200,000 female adults were counted and several of these caves showed signs of human disturbance (Gore and Hovis 1992, Nature Serve 2003). It is thought that Florida still has large numbers of this species although there has been a 45-50% decline in the last 30-40 years (Nature Serve 2003). Over 40 officials from states within the range of southeastern myotis have agreed that this species is in decline and should be federally listed as threatened (Hofmann et al. 1999). According to National Biological Resources (1995), Rafinesque's big-eared bat and southeastern myotis are at risk of extinction. Because total populations of both species are thought to be declining (Gore and Hovis 1992, Clark 2000b, Bat Conservation International 2001, Kentucky Bat Working Group 2003), further research is needed to determine the status of regional and local populations.

Habitat Needs

One of the primary causes for bat population declines in the southeastern United States is habitat destruction (Fenton 1983, Clark 2000b). The loss of BLH forests is a prime example of the reduction of ideal bat habitat. These forests were once common in the Southeast, and existing stands contain some of the best remaining habitats for bats. Studies conducted by Cochran (1999) and Clark (2000a) have shown that mature BLH forests are used by 11 of 18 bat species found in the East, including Rafinesque's big-eared bat and southeastern myotis. BLH forests are becoming greatly reduced due to silviculture practices that eliminate mature stands. Fifty-six percent of southern BLH and bald cypress forests were lost between 1900 and 1978 (Bass 1989). Remaining BLH forests are often fragmented. Rafinesque's big-eared bat is reluctant to cross large open areas between roosts (Clark 2000b), making fragmented habitats unsuitable for this species.

BLH forests provide optimal foraging habitat for Rafinesque's big-eared bat and southeastern myotis and often contain large, buttressed trees with cavities for roosting (Horner and Maxey 1998, Clark 2000b). Both species have been found to roost in black gum (*Nyssa sylvatica),* water tupelo, and bald cypress trees with large diameters and a triangular opening at the base (Horner and Maxey 1998, Clark 2000b, Trousdale and Beckett 2001). Roost trees provide sites for mating, hibernation, and rearing of young as well as protection from harsh weather and predators (Kunz 1982). Bats spend over half

of their time in roosts, which are considered a limiting factor for Rafinesque's big-eared bat and southeastern myotis (Clark 2000a). As a result of declining habitat, these species can often be found in alternative roost sites such as abandoned houses (Hall 1999, Trousdale and Beckett 2000, Sherman 2004), old cisterns (Harvey et al. 1999, Sherman 2004), and bridges (Trousdale and Beckett 2000, Lance and Garrett 1997). In fact, the majority of known maternity colonies of Rafinesque's big-eared bat are found in abandoned and decayed buildings (Barbour and Davis 1969). The largest maternal colonies known in Mississippi are located in abandoned buildings for Rafinesque's big-eared bat and cisterns for southeastern myotis (Sherman 2004).

GOALS/OBJECTIVES:

The objectives for this project were to: 1. conduct surveys to examine overall bat species composition, relative abundance of individuals, and activity on Theodore Roosevelt NWR Complex, 2. identify bat foraging and roosting habitats with an emphasis of those being used by Rafinesque's big-eared bat and southeastern myotis, 3. examine colony dynamics at roosts with regard to sex/age class characteristics and number of individuals, 4. determine critical time periods and locations corresponding to reproductive behaviors, and 5. provide management suggestions to aid in conservation practices.

STUDY AREA

Four refuges within the Theodore Roosevelt National Wildlife Refuge (NWR) Complex were the focus for this study: Yazoo, Panther Swamp, Hillside, and Morgan Brake. With 52,500 acres of BLH forests, these refuges provide ideal habitats for bats, particularly Rafinesque's big-eared bat and southeastern myotis, although none had previously been surveyed. Several bat species had been captured near the Complex in the Delta National Forest. During mist net surveys conducted by Lann Wilf, MS Department of Wildlife, Fisheries, and Parks, from 1999 - 2001, evening bats (*Nycticeius humeralis*) were the most commonly captured species (59% of captures) with southeastern myotis being the second most abundantly captured species (22% or 153 individuals). Using radio telemetry, three tree roosts were located for southeastern myotis during this study including sweetgum, *(Liquidamber styraciflua)*, Nuttall oak (*Quercus texana*), and water hickory (*Carya aquatica*) trees. Two Rafinesque's big-eared bats were also captured during this project. The following common species would be expected to be found on the Theodore Roosevelt NWR Complex; red bat (*Lasiurus borealis*), evening bat, big brown bat (*Eptesicus fuscus*), Brazilian free-tailed bat (*Tadarida brasiliensis*), Seminole bat (*Lasiurus seminolus*), and eastern pipistrelle (*Pipistrellus subflavus*). The following special concern species would be expected to be found on the refuge complex; hoary bat, Rafinesque's big-eared bat, and southeastern myotis.

METHODS

Mist Net Surveys

GPS coordinates were attained for all water bodies close to roads on Morgan Brake NWR, Hillside NWR, Panther Swamp NWR, and Yazoo NWR using topographic maps in ArcView 3.3. These sites were located in the field using a global positioning

system (GPS) (Garmin Etrex Vista) to determine mist net and/or AnaBat suitability. Mist net surveys were conducted at suitable sites twice a month from April – May, 6 times a month in July and August and 4 times a month in June, September and October, 2007 to determine habitat usage by Rafinesque's big-eared bat and southeastern myotis and species diversity. Surveys were conducted using mist nets (6 m. – 18 m. length, 30 mm mesh, Avinet) with nets being opened 15 minutes before sunset and closed approximately four hours later. A minimum of three nets were used per site and were placed above waterways, dirt roads, or other potential flyways. Ambient temperature, relative humidity, and other relevant climatic conditions were recorded when nets were first raised and closed for the evening. Nets were checked every fifteen minutes for captured bats.

Morphometric Data and Standard Measurements

Upon capture, bats were identified to species and sex. Reproductive status (pregnant, lactating, or scrotal) was derived using methods described by Kunz (1988). Age class was estimated by pelage color (Jones and Suttkus 1975) and degree of ossification of epiphyseal caps on phalanges of fingers (Kunz 1988). Weight, using a spring scale (30g. Pesola Micro-Line), and forearm length, using a plastic dial caliper (Forestry Suppliers) was determined. The time and location of the bat in the net was noted. Diagrams of net placement were made and the habitat type of each site was determined using a Mississippi community key (Mississippi Natural Heritage Program b, 2001). Water body dimensions (depth, length) were estimated and the location of capture was recorded using a GPS.

Anabat Surveys

To obtain additional information concerning bat activity and species diversity on Theodore Roosevelt NWR Complex, an AnaBat II Bat Detector (Titley Electronics) was used at 8 locations (2 locations on each refuge) over 20 nights. An AnaBat Bat Detector produces audible output from the ultrasonic (and therefore generally inaudible) sounds which bats generate in order to echolocate. All echolocation calls detected by the AnaBat Detector were recorded using an AnaBat CF Storage Zcaim (Titley Electronics) and downloaded into a personal computer. Calls are currently being analyzed to determine bat species.

Roost Surveys

To locate roosts, all bridges and abandoned buildings located on the refuge complex were surveyed for bat occupancy. Characteristics of each bridge were noted including dimensions, presence of water underneath the bridge, waterway dimensions, and bridge substrate and design. Characteristics of abandoned buildings were documented including dimensions, condition, and surrounding habitat.

In addition, 750 acres were surveyed on foot to locate suitable trees and roosts. Locations were chosen on each refuge based on suitable habitat for Rafinesque's big-eared bat and southeastern myotis. GPS coordinates were taken at 100 foot intervals to accurately map areas surveyed. All trees within the survey area with basal cavities were inspected using a spotlight to determine bat occupancy.

Radio telemetry was also used in an attempt to locate roosts. After capture via mist net, 11 southeastern myotis individuals were fitted with a LB-2N radio transmitter (Holohil Systems Ltd.). Using a telemetry receiver and a 3-element folding antenna (Holohil Systems Ltd.), attempts were made to track individuals for a minimum of 4 days each.

RESULTS

Mist Net Surveys

Sixty-one sites were scouted in the field on Morgan Brake NWR, Hillside NWR, Panther Swamp NWR, and Yazoo NWR to determine mist net suitability. Mist net surveys were conducted at 23 sites over 28 nights (5 sites at Morgan Brake NWR and 6 sites each at Hillside NWR, Panther Swamp NWR, and Yazoo NWR). A total of 201 bats were captured representing 5 species averaging 7.18 bats captured per net night (Figure 1). Forty-seven southeastern myotis were captured representing 22% of the total number of bats captured. Other bat species captured during the survey period included the: evening bat (74% of the total bat captures), red bat (3%), Seminole bat (0.5%), and Eastern pipistrelle (0.5%). Out of the 4 refuges, Panther Swamp NWR had the highest capture average with 12.88 bats captured per net night (Figure 2). Capture averages for the other 3 refuges were: 6.5 bats captured per net night at Yazoo NWR, 2.8 at Hillside NWR, and 4.57 at Morgan Brake NWR. Yazoo NWR had the highest species diversity with 5 species captured (red bat, evening bat, southeastern myotis, Seminole bat, and Eastern pipistrelle) (Figure 2). Three species (red bat, evening bat, and southeastern myotis) were captured each at the other 3 refuges.

Morgan Brake NWR

Morgan Brake NWR consists of 7,400 acres, 4,000 of which is bottomland hardwood forests. Five sites on Morgan Brake NWR were surveyed over 7 nights. Thirty-two bats were captured averaging 4.57 bats captured per net night representing 3 species (Figure 3 and Table 1). Southeastern myotis was the most prevalently captured species with 18 bats captured representing 57% of the total bats captured. Other species captured were the: evening bat (33% of total captures) and red bat (10%).

Eighty-one percent of the total captures occurred at one site (Site #MB8). Site #MB8 was a small creek/tributary to Tchula Lake ~ 1 - 7 m wide and 0.10 – 1.5 deep with a mucky substrate. The water was clear with a fast flowing current. Logs and debris crossed the creek. Bald cypress was found along the banks and within the creek. The area was surrounded by a mixed bottomland hardwood forest. Dominant tree species were bald cypress (*Taxodium distichum*). Other species surrounding the creek was honey locust (*Gleditsia triacanthos*). Only 1 site out of 5 resulted in no bat captures. This site was the only one chosen that did not have a stream or pond. Instead nets were placed within the forest interior. Southeastern myotis was captured at 4 out of 5 sites. See Appendix A for habitat characteristics of all sites.

Hillside NWR

Hillside NWR consists of 15,500 acres, 12,000 of which is bottomland hardwood forests. Five sites were surveyed over a five night period. A total of 14 bats were captured

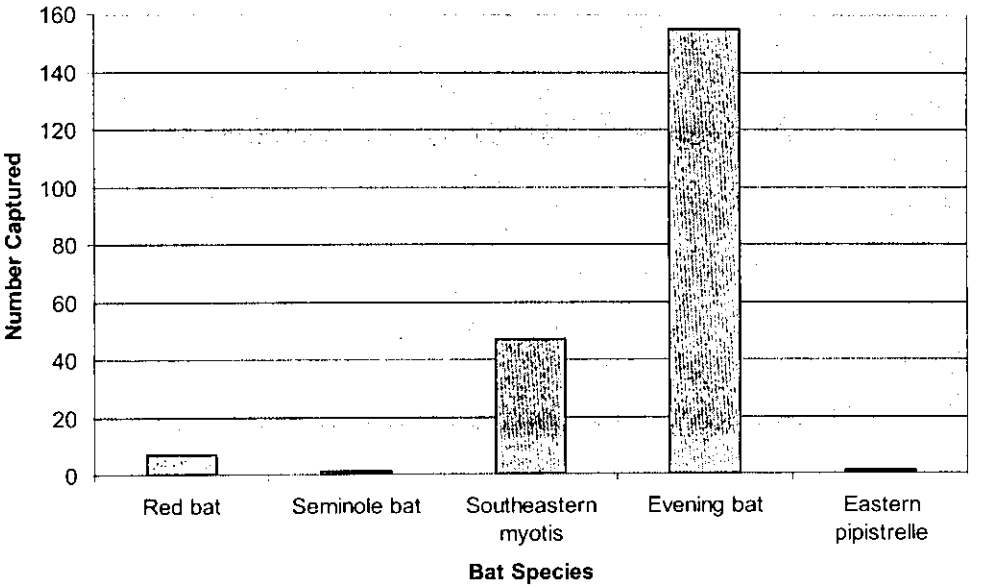

Figure 1. Number of bats captured per species during mist net surveys conducted at 4 refuges within Theodore Roosevelt NWR Complex from April - October, 2007.

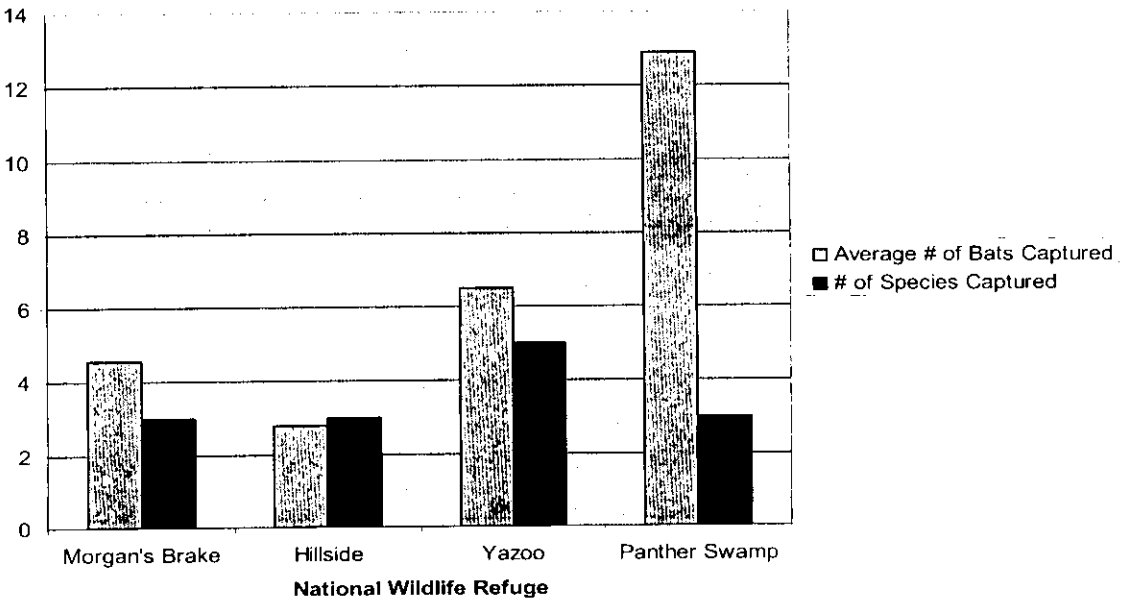

Figure 2. Average number of bats captured per net night and number of species captured at 4 refuges within Theodore Roosevelt NWR Complex during mist net surveys conducted from April – October, 2007.

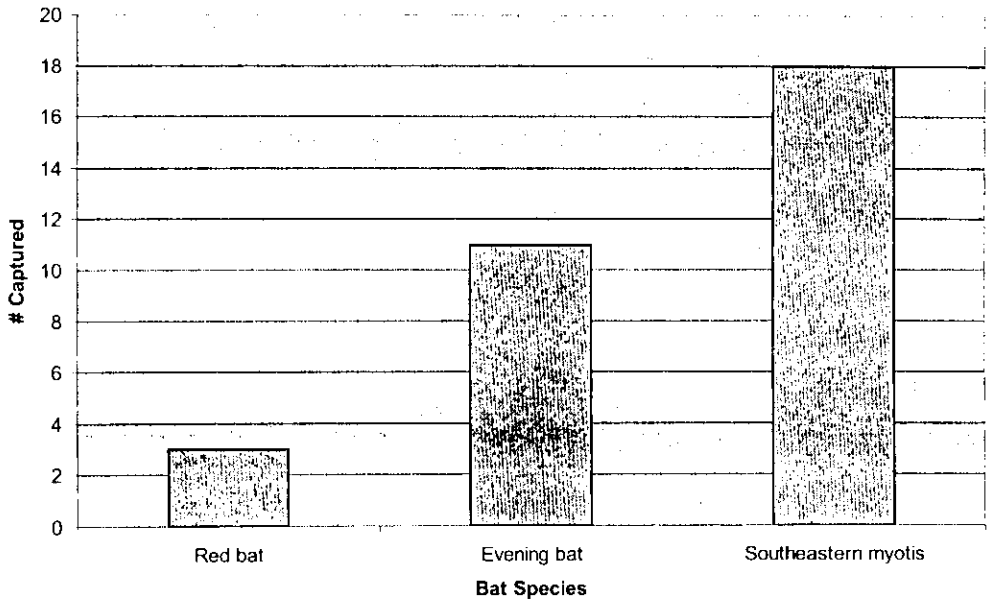

Figure 3. Number of bats captured per species at Morgan Brake NWR during mist net surveys conducted from April – October, 2007.

Table 1. Mist net survey site information for bats captured at Morgan Brake NWR during surveys conducted from April – October, 2007.
Note: MYAU = southeastern myotis, NYHU = evening bat, and LABO = red bat.

SITE #	DATE	LOCATION	SPECIES	#
MB4	4/26/07	MB NWR, Providence Rd. E of HQ	MYAU	1
MB5	5/22/07	MB NWR, Slough off Providence Rd. E of Site #MB4	LABO MYAU	1 1
MB8	6/12/07	MB NWR, Creek crossing HWY 49E, N of Providence Rd.	NYHU MYAU	1 2
MB8	8/16/07	MB NWR, Creek crossing HWY 49E, N of Providence Rd.	NYHU LABO MYAU	10 1 12
MB11	8/23/07	MB NWR, Tupelo stand on E side of HWY 49 E (N) just S of MB8	MYAU LABO	2 1
MB13	10/12/07	MB NWR, Bluff on S end of refuge	0	
MB8	10/20/07	MB NWR, Creek crossing HWY 49E, N of Providence Rd.	0	

averaging 2.8 bats captured per net night representing 3 species (Figure 4 and Table 2). One southeastern myotis was captured representing 7% of the total bat captures. Other species captured included the: evening bat (79% of total captures) and red bat (14%).

Bats were captured at all 5 sites. The southeastern myotis was captured at Site #HS11. Site #HS11 was a tupelo/cypress swamp ~ 40 m wide and at least 100 m long. Water depth ranged from 0.25 – 1.25 m with a mucky substrate. The swamp contained large amounts of leaf litter and logs in the water. This site was surrounded by a bottomland hardwood forest. Dominant tree species were water tupelo (*Nyssa aquatica*) and bald cypress (*Taxodium distichum*). Other tree species were: silver maple (*Acer saccharinum*).

Panther Swamp NWR

Panther Swamp consists of 38,600 acres, 30,000 of which is bottomland hardwood forests. Six sites were surveyed over 8 nights. A total of 103 bats were captured averaging 12.88 bats captured per net night representing 3 species (Figure 5 and Table 3). Ten southeastern myotis individuals were captured representing 10% of the total captures. Other species captured included the: evening bat (89 % of total captures) and red bat (1%).

Bats were captured at all 8 sites. Southeastern myotis individuals were captured at Sites # PS14, PS19, PS20, and PS21. Site #PS14 was a slough area ~10 X 40 m and 0.10 – 0.50 m deep with a clayey substrate. Some logs in water and small trees in water along banks. This site was surrounded by a bottomland hardwood forest. Dominant tree species were overcup oak (*Quercus lyrata*), willow oak (*Q. phellos*), honey locust (*Gleditsia triacanthos*), and water hickory (*Carya aquatica*). Other species included slippery elm (*Ulmus rubra*) and sugarberry (*Celtis laevigata*). Site #PS19 was a water ditch draining from a marsh running parallel to a gravel road. The ditch was ~ 4 – 6 m wide, 18 m long and 0.10 – 1 m deep with a silty substrate surrounded by a bottomland hardwood forest. Dominant species along the ditch and road included: laurel oak, overcup oak (*Q. lyrata*), pecan (*Carya illinoensis*), and eastern hornbeam. Site #PS20 was a water tupelo stand ~ 0.10 – 0.50 m deep with a mucky substrate. Logs, debris, and trees were in the water. Dominant tree species were water tupelo (*Nyssa aquatica*). Other species were sugarberry (*Celtis laevigata*). Site #PS21 was a medium size creek ~ 6 -20 m wide and 0.10 – 0.75 m deep with a silty substrate surrounded by a bottomland hardwood forest. Dominant species along the creek bank included small: button bush (*Cephalantis occientalis*), possomhaw holly (*Ilex decidua*), pecan (*Carya illinoensis*), and sugar berry (*Celtis laevigata*). Dominant species away from the banks included: overcup oak (*Quercus lyrata*), willow oak (*Q. phellos*). These trees ranged from 18 – 25 m tall with little understory.

Yazoo NWR

Yazoo NWR consists of 13,000 acres, 6,500 of which is bottomland hardwood forests. Six sites were surveyed over 8 nights. Fifty-two bats were captured averaging 6.5 bats captured per net night representing 5 species (Figure 6 and Table 4). Eighteen southeastern myotis were captured representing 36% of the total captures. Other species captured included the: evening bat (61% of the total captures), red bat (1%), Seminole bat (1%), and eastern pipistrelle(1%).

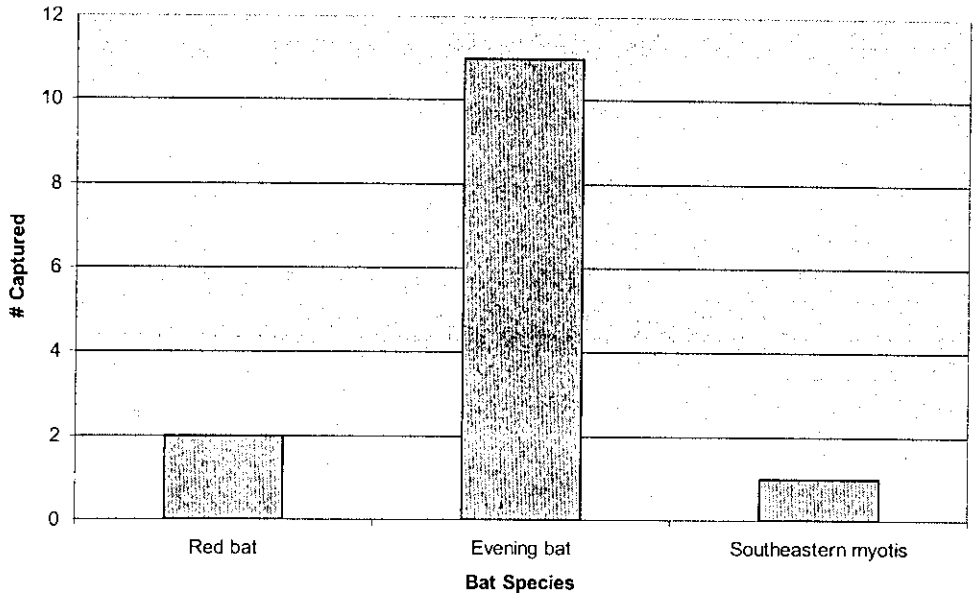

Figure 4. Number of bats captured per species during mist net surveys conducted at Hillside NWR from April – October, 2007.

Table 2. Mist net survey site information for bats captured at Hillside NWR during surveys conducted from April – October, 2007.
Note: MYAU = southeastern myotis, NYHU = evening bat, and LABO = red bat.

SITE #	DATE	LOCATION	SPECIES	#
HS1	4/27/07	HS NWR, Alligator Slough	NYHU	1
HS15	5/21/07	HS NWR, Tipton Bayou 1/4 mile down rd.	NYHU	2
HS11	7/26/07	HS NWR, Swamp on E side of Levee Rd. ~ 2 miles E/NE of HWY 49 E	MYAU NYHU LABO	1 4 1
HS2	7/27/07	HS NWR, Tipton Bayou N of Site #HS15	NYHU LABO	2 1
HS4	8/24/07	HS NWR, Fannegusha Creek, < 1/8 of a mile S on W levee rd	NYHU	2

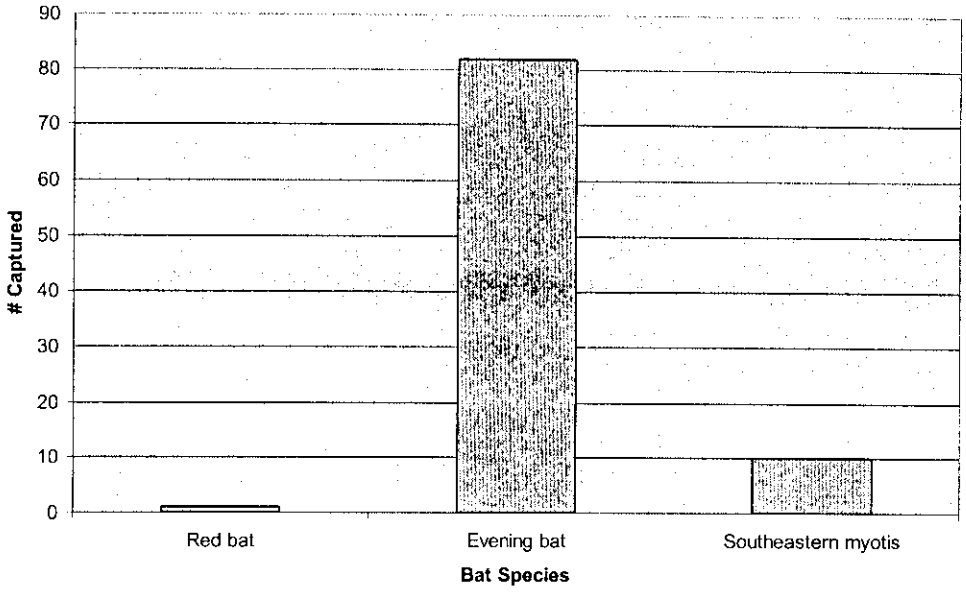

Figure 5. Number of bats captured per species during mist net surveys conducted at Panther Swamp NWR from April – October, 2007.

Table 3. Mist net survey site information for bats captured at Panther Swamp NWR during surveys conducted from April – October, 2007.
Note: MYAU = southeastern myotis, NYHU = evening bat, and LABO = red bat.

SITE #	DATE	LOCATION	SPECIES	#
PS5	7/28/07	PS NWR, W portion of refugee, S of cleared land	NYHU	8
PS13	8/7/07	PS NWR, Off power line gravel rd. leading to Duck Camp	NYHU	4
PS14	8/17/07	PS NWR, Pipeline gravel road E of E levee towards Duck Camp, W of Site #PS13	NYHU MYAU	19 2
PS20	8/18/07	PS NWR, Gravel Rd. behind Head Quarters	NYHU MYAU LABO	10 3 1
PS14	9/6/07	PS NWR, Pipeline gravel road E of E levee towards Duck Camp, W of Site #PS13	NYHU	17
PS20	9/7/07	PS NWR, Gravel Rd. behind Head Quarters	MYAU NYHU	1 2
PS21	10/13/07	PS NWR, Tributary to Panther Creek off Pipeline Rd.	NYHU MYAU	10 1
PS19	10/19/07	PS NWR, Water ditch draining into marsh off of gravel rd. S of road leading to refuge head quarters	NYHU MYAU	22 3

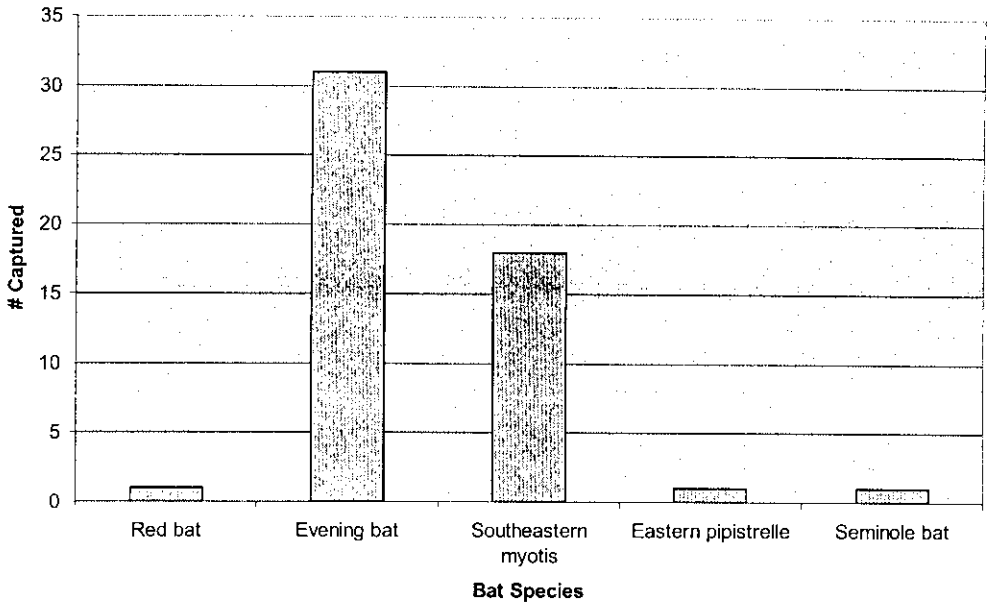

Figure 6. Number of bats captured per species during mist net surveys conducted at Yazoo NWR from April – October, 2007.

Table 4. Mist net survey site information for bats captured at Yazoo NWR during surveys conducted from April – October, 2007.
Note: MYAU = southeastern myotis, NYHU = evening bat, LABO = red bat, LASE = Seminole bat, and PISU = eastern pipistrelle.

SITE #	DATE	LOCATION	SPECIES	#
YZ2	6/27/07	YZ NWR, Hoots Dump Slough, SW of HQ	NYHU MYAU LASE	6 3 1
YZ4	8/1/07	YZ NWR, Closed area on gravel rd. going W off Yazoo Refuge Rd.	MYAU	3
YZ14	6/28/07	YZ NWR, Creek off Surveilance Station Rd.	0	
YZ17	7/18/07	YZ NWR, Slough off gravel rd. going to Lizards Lake	NYHU	1
YZ4	7/19/07	YZ NWR, Closed area on gravel rd. going W off Yazoo Refuge Rd.	MYAU NYHU PISU	7 1 1
YZ1	7/20/07	YZ NWR, Hoots Dump Slough, SW of HQ, N of Site #YZ20		
YZ2	9/20/07	YZ NWR, Hoots Dump Slough, SW of HQ	NYHU MYAU	4 2
YZ8	9/21/07	YZ NWR, Tributary to Silver Lake	NYHU LABO MYAU	19 1 3

Bats were captured at 4 of the six sites. Southeastern myotis individuals were captured at 3 sites; Sites #YZ2, YZ4, and YZ8. Site #YZ2 was a slough/swamp area with periodic pools ranging from 20 – 30 X 40 – 60 m and 0.10 – 1.5 m in depth. The site was surrounded by a bottomland hardwood forests with some cypress located in the water. Dominant tree species were bald cypress (*Taxodium distichum*), swamp privet, and post oak (*Quercus lyrata*). Other vegetation included: water oak (*Q. nigra*), sweetgum (*Liquidambar styraciflua*), sugarberry (*Celtis laevigata*), persimmon (*Diospyros virginiana*), pecan (*Carya illinoensis*), and American elm (*Ulmus americana*). Site #YZ4 was a ditch running parallel to the road that was periodically filled with water ~ 4 m wide and 0.10 – 1.10 deep. The ditch had deeply incised banks with a clayey muck substrate. This site was surrounded by an old growth mixed hardwood forest. Dominant tree species were sweetgum (*Liquidambar styraciflua*), box elder (*Acer negundo*), black locust (*Robinia pseudoacacia*), sugarberry (*Celtis laevigata*), green ash (*Fraxinum pennsylvanica*), slippery elm (*Ulmus rubra*). Site #YZ8 was a thin creek ~ 8 - 10 m wide and 0.25 – 1.25 m deep with a silty clay substrate. The creek had deeply incised banks and was surrounded by a mixed hardwood buffer. Fallow cropland surrounded the streamside zone. Dominant tree species were bald cypress (*Taxodium distichum*), red maple (*Acer rubrum*), winged elm (*Ulmus alata*), honey locust (*Gleditsia triacanthos*), green ash (*Fraxinus pennsylvanica*), and box elder (*A. negundo*) .

Anabat Surveys

To further document species diversity and relative bat activity on the refuges, an AnaBat Bat Detector was used at 8 locations over 16 nights from June – September, 2007. Over 10,000 calls were recorded and are currently being analyzed to determine suitability for analysis and to identify bat species.

Roost Surveys

Man-made Roosts

One abandoned house located on Panther Swamp NWR and 24 bridges located on Morgan Brake NWR (4 bridges), Hillside NWR (8), Panther Swamp NWR (4), and Yazoo NWR (8) were surveyed for bat occupancy. Bats have been documented to prefer concrete bridges over wood bridges and those bridges with cells or recessed areas as opposed to a flat slab bridge (Lance 2001, Trousdale and Beckett 2002). Eight of the 24 bridges surveyed were deemed suitable as roost sites because they were concrete bridges with multiple recessed cells underneath. Eleven bridges were deemed as probably suitable because they had similar characteristics as documented preferred bridges with minor differences (i.e. – large cells). Four bridges were deemed as probably not suitable because either the cells were way too large or the concrete bridge was built on wood pilings that smelled of creosote. One bridge was deemed as not suitable because it was a flat concrete slab bridge. No bats or evidence of bats were observed in the abandoned house or under any of the bridges on the date surveyed.

Natural Roosts

Over 750 acres were scouted on foot in an attempt to locate tree roosts for Rafinesque's big-eared bat and southeastern myotis. Hundreds of cavity trees were located however no bats were observed. Maps are currently being made of survey locations and will be included in the final report.

Telemetry Surveys

Eleven southeastern myotis individuals were fitted with radio telemetry transmitters in an attempt to locate roosts. Although signals were detected, no roosts were located. Maps displaying capture points and areas where signals were detected are currently being made and will be included in the final report.

CONCLUSION

Mist Net Surveys

Species Abundance and Diversity

Morgan Brake NWR, Hillside NWR, Panther Swamp NWR, and Yazoo NWR were 4 of 14 study areas in MS where intensive mist net surveys were conducted from March 2002 – October 2007 (McCartney 2007). Other study areas included: St. Catherine Creek NWR, Noxubee NWR, Laurel Hill Plantation (a private land holding adjacent to St. Catherine Creek NWR), Camp Shelby, Camp McCain, Meridian Naval Air Station (NAS), Caney Creek Wildlife Management Area (WMA), Divide Section WMA, and Canal Section WMA. Out of these 14 study areas, Panther Swamp NWR had the highest capture average (averaging 12.88 bats captured per net night) Panther Swamp NWR contains 30,000 acres of bottomland hardwood forest with a diverse fauna. Studies conducted by Miller (2004b) have shown that species diversity and relative abundance of bats in an area can be considered indicators of overall forest health. This implies a positive linear relationship in which with the increase of health and diversity of a forest there will be an increase in bat activity and species diversity. Results from this study help to confirm this theory.

Southeastern Myotis and Rafinesque's Big-eared Bat

Southeastern myotis was the second most prevalently captured species representing 22 % of the total captures. Considering that this species is a species of special concern, this is highly unusual. Theodore Roosevelt NWR Complex contains ideal habitat for both southeastern myotis and Rafinesque's big-eared bat.

Rafinesque's big-eared bat has been documented as being hard to capture using mist net survey methods. For example, surveys conducted by Trousdale and Beckett (2002) in southern Mississippi yielded no captures of Rafinesque's big-eared bat, although surveys took place near known roost sites for this species. Lance and Garrett (1997) only had 1 capture for this species during extensive mist net surveys in Louisiana, although some surveys took place near known roost sites. Although there were no captures for this species during this study I think it is very likely that this species occurs in this area.

Additional mist net and anabat surveys are needed to increase data determining foraging habitats for Rafinesque's big-eared bat and southeastern myotis at Theodore Roosevelt NWR Complex.

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